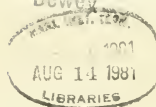


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EFFECTS OF NOMINAL CONTRACTING
ON STOCK RETURNS

by

Richard S. Ruback
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WP # 1231-81

July 1981

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Abstract

In this paper we estimate the effects of unexpected inflation on the returns to the common stock of companies with different short-term monetary positions, different long-term monetary positions, and different amounts of nominal tax shields. Unlike most previous studies of the effects of nominal contracting, we are careful to distinguish between expected and unexpected inflation in our tests. Surprisingly, over the 1947-79 period we find no evidence that stockholders of net debtor firms are benefitted by unexpected inflation relative to the stockholders of net creditor firms. We suggest some possible explanations for this puzzling result.

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Effects of Nominal Contracting on Stock Returns

1. Introduction

Nominal contracts stipulate payment of a fixed number of dollars at a pre-specified future date. The parties involved in the contract estimate the present value of the future payment taking into account the inflation which is expected to occur over the course of the contract. The deviations of the actual inflation rate from its expected value redistribute wealth between the parties to the nominal contract. Unexpected inflation increases the wealth of the debtor and decreases the wealth of the creditor, while unexpected deflation (or negative unexpected inflation) has the opposite effect.

The nominal contracting hypothesis has been studied extensively by examining the relationship between common stock returns and inflation. Kessel [1956], Bach and Ando [1957], Alchian and Kessel [1959], Kessel and Alchian [1960], Bach and Stephenson [1974], and Hong [1977], among others, compare the common stock returns of net debtor and net creditor companies in periods with different inflation rates. These studies are not, however, valid tests of the nominal contracting hypothesis since they do not distinguish between expected and unexpected inflation. For example, observing no difference between the risk adjusted common stock returns of debtor and creditor firms during a period of high inflation provides no evidence regarding the validity of the nominal contracting hypothesis. If high inflation was anticipated when nominal contracts were written, there should be no difference in the stock

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returns to net debtors versus net creditors. Since, by definition, unexpected inflation is serially uncorrelated with a mean of zero, the periods of high inflation used in previous tests probably correspond to periods of high expected inflation.

To construct a proper test of the nominal contracting hypothesis, it is necessary to measure the comovement of stock returns and unexpected inflation. This comovement is examined in a number of papers, including Bodie [1976], Jaffe and Mandelker [1976], Nelson [1976b], Fama and Schwert [1977] and Schwert [1981]. However, these papers only use an aggregate portfolio of common stocks; they do not make cross-sectional comparisons among firms with different sets of nominal contracts.

This paper tests the nominal contracting hypothesis by forming groups of firms with different monetary positions and comparing the sensitivity of their stock returns to unexpected inflation. We examine the separate effects of the short-term monetary position, the long-term monetary position, and the monetary position implicit in tax shields. By carefully distinguishing between expected and unexpected inflation, this paper remedies a serious flaw that existed in most previous tests of the nominal contracting hypothesis.

2. Differential Effects of Unexpected Inflation

A. Distributional Effects

Kessel and Alchian [1962] note that unexpected inflation benefits firms which contract to pay a fixed number of dollars in the future (debtors) and it hurts firms which contract to receive a fixed number of dollars in the future (creditors). Of course, the wealth redistribution caused by unexpected inflation is not limited to financial contracts such as corporate debt. The value of any contract which specifies future payments or receipts in fixed nominal terms is affected by unexpected inflation, including long-term labor contracts, raw materials contracts, pension commitments, finished good contracts, and any other contract which does not have inflation adjustment clauses. For example, there are distributive tax effects as a result of unexpected inflation. Since depreciation and inventory expense are based on historical costs, rather than current replacement costs, unexpected inflation which affects all prices simultaneously increases revenues without an offsetting increase in depreciation and inventory expense, thus increasing the tax burden of the firm.¹

Another reason why unexpected inflation could be related to stock returns is that current unexpected inflation might contain new information about future levels of expected inflation. Fama [1975, 1976] argues that movements in the term structure of interest rates seem to be dominated by inflationary expectations. If expectations of future inflation are higher,

nominal interest rates will rise to reflect the level of expected inflation. This will cause a loss to debtholders, and a corresponding gain for the stockholders of a levered firm. Similar effects occur for other long-term fixed price contracts. While unexpected inflation affects the current price level, a change in the expected inflation rate has additional effects on the price level in future periods.

The distributive effects of an unanticipated change in expected inflation are greater the longer the term of the contract. The value of current liabilities, such as accounts payable, changes by the amount of the unexpected inflation. The value of long-term debt, however, is reduced by a multiple of unexpected inflation, because the current value of all future cash payouts is reduced. Thus, it is important to consider the time pattern of payoffs which are specified in different contracts when measuring the monetary position of a given firm.

B. Information Effects

Besides the distributional effects of expected and unexpected inflation, unexpected inflation could be related to other macroeconomic phenomena which affect stock values. Unexpected inflation could convey information about other events which would have an indirect effect on stock returns. For example, if an unexpected change in expected inflation causes government policy makers to react by changing monetary or fiscal policy, these

policy decisions could affect investment and therefore stock returns. If firms are affected by these policy decisions in different ways, then the information effects of unexpected inflation would differ across firms. These differential effects could distort the distributive effects which result from nominal contracting.

Fama [1979] argues that unexpected inflation is correlated with real macroeconomic activity, such as capital expenditures, over the 1953-77 period. Thus, following Fama's argument, the negative correlation between aggregate stock returns and unexpected inflation during this period is due to an information effect. However, since Fama works with an aggregate stock portfolio there is no way to tell whether the information effects of unexpected inflation vary across firms.

3. Models for Unexpected Inflation

A number of models for predicting inflation have been suggested in the literature. Univariate ARIMA models have been used by Nelson [1976], Bodie [1976], Nelson and Schwert [1977] and Schwert [1981], among others.² Fama [1975] and Fama and Schwert [1977], among others, use the short-term interest rate on a default-free discount bond to measure expected inflation under the assumption that the expected real rate of interest is constant over time. Fama [1979], Plosser [1980], and others suggest using variables such as the growth rate of the money supply and the rate of industrial production, in addition to lagged inflation and interest rates to estimate expected inflation. Since our tests critically depend on estimating comovements of stock returns and unexpected inflation, we consider a variety of measures of unexpected inflation. We use three criteria to choose the "best" measure of unexpected inflation:

- (1) The unexpected inflation measure should have a relatively small variance, so that all predictable movements in inflation are eliminated (this is important to reduce errors-in-variables problems in estimating the comovement of stock returns and unexpected inflation.)³
- (2) The coefficients of the prediction model should be stable over time so that it is legitimate to interpret fitted residuals as estimates of unexpected inflation.

- (3) The measure of unexpected inflation should be negatively correlated with the returns to corporate debt, since the wealth distribution hypothesis presumes that stockholders gain at the expense of bondholders. Note that the nominal price of bonds should not be affected by unexpected inflation unless there is also an unexpected change in future expected inflation.

Inflation is defined as a simultaneous equal proportionate increase in the money prices of all goods. In reality, prices of different goods change at different rates, so there is a problem in defining an overall inflation rate. In recognition of this fact we consider three different price indices to measure the quarterly inflation rate in the United States for the 1947-79 period: (a) the Consumer Price Index (CPI), (b) the deflator for the personal consumption component of Gross National Product (DEF), and (c) the deflator for the nondurable goods component of personal consumption (DEFN). The first eight autocorrelations, means, and standard deviations of these inflation rates are in Table 1.

Based on the autocorrelations in Table 1 and further data analysis, we estimate third-order autoregressive models (AR(3)) for each of the inflation series in Part A of Table 2. Part A of Table 2 also contains an asymptotic F-test of the hypothesis that the model parameters are constant across the 1947-63 and 1964-79 subperiods. Part B of Table 2 contains the first eight autocorrelations of the unexpected inflation rates from these univariate time series models and the correlation of

Table 1
Summary Statistics for Quarterly Inflation Rates, 1947-79*

<u>Price Index</u>	<u>r₁</u>	<u>r₂</u>	<u>r₃</u>	<u>r₄</u>	<u>r₅</u>	<u>r₆</u>	<u>r₇</u>	<u>r₈</u>	<u>S(r)</u>	<u>Mean</u>	<u>Standard Deviation</u>
Consumer Price Index, CPI	.60	.46	.51	.37	.21	.16	.15	.11	.09	.0096	.0101
Personal Consumption Deflator, DEF	.62	.58	.51	.33	.27	.20	.12	.16	.09	.0092	.0078
Nondurable Consumption Deflator, DEFN	.70	.54	.46	.23	.13	.07	-.02	-.03	.09	.0087	.0106

* r_k is the autocorrelation coefficient at lag k , $S(r)$ is the asymptotic standard error of the autocorrelation coefficients under the hypothesis of zero autocorrelation at all lags.

the unexpected inflation rate with the quarterly holding period return to a portfolio of long-term corporate bonds obtained from Ibbotson and Sinquefield [1979]. The corporate bond returns are not available for 1979.

Several things are notable about the results in Table 2. First, the AR(3) specification seems adequate since the residual autocorrelations are small and insignificantly different from zero. Second, unexpected inflation rates are negatively correlated with the corporate bond returns CB_t , with the largest correlation occurring for the unexpected CPI inflation rate. Finally, however, the univariate time series models are inadequate since the F-tests indicate that the coefficients are not equal in the 1947-63 and 1964-79 subperiods.

In order to generalize our model for expected and unexpected inflation, we consider the regression model

$$\rho_t = \alpha_0 + \sum_{i=1}^3 \alpha_i \rho_{t-i} + \beta_1 TB_t + \sum_{j=1}^2 \beta_{2j} IP_{t-j} + \sum_{k=1}^2 \beta_{3k} M_{t-k} + u_t, \quad (1)$$

where ρ_t is the quarterly inflation rate, TB_t is the yield to maturity on a three month treasury bill (which is known at the beginning of the quarter), IP_{t-j} is the growth rate of industrial production for nondurable consumption goods in quarter $t-j$, and M_{t-k} is the growth rate of the monetary base in quarter $t-k$.⁴ The regression model (1) contains several models as special cases: (a) if the coefficients on TB_t , IP_{t-j} , and M_{t-k} are all zero, then the AR(3) univariate model is correct; (b) if the lag

Table 2

Univariate ARIMA Models for Quarterly Inflation, 1947-79

Part A: AR(3) Models $\frac{a}{b}$

$$p_t = a_0 + a_1 p_{t-1} + a_2 p_{t-2} + a_3 p_{t-3} + u_t$$

Price Index	$\frac{a}{u}$	$\frac{a_1}{u}$	$\frac{a_2}{u}$	$\frac{a_3}{u}$	$\frac{S(u)}{u}$	F-test for Stability
CPI	.0017 (.0009)	.505 (.076)	-.040 (.084)	.356 (.078)	.0068	4.79**
DEF	.0018 (.0008)	.368 (.088)	.262 (.091)	.158 (.088)	.0056	4.13**
DEFN	.0019 (.0009)	.656 (.088)	.009 (.105)	.116 (.089)	.0073	2.63*

Part B: Summary Statistics for Unexpected Inflation, u_t $\frac{b}{u}$

	$\frac{r_1}{u}$	$\frac{r_2}{u}$	$\frac{r_3}{u}$	$\frac{r_4}{u}$	$\frac{r_5}{u}$	$\frac{r_6}{u}$	$\frac{r_7}{u}$	$\frac{r_8}{u}$	$\frac{S(r)}{u}$	$\frac{\text{Corr}(u, CB_t)}{u}$
CPI	.10	.11	.02	.11	.05	-.18	-.07	-.19	.09	-.27
DEF	.00	.10	.08	-.06	.00	-.11	-.18	-.05	.09	-.21
DEFN	.01	.05	.16	-.13	-.04	-.04	-.13	-.10	.09	-.22

$\frac{a}{b}$ Standard errors are in parentheses. $S(u)$ is the estimate of the standard deviation of unexpected inflation. The F-test for stability tests the hypothesis that a_0, a_1, a_2 , and a_3 are the same in the 1947-63 and 1964-79 subperiods, so the degrees of freedom are (4,121).

$\frac{b}{r_k}$ is the autocorrelation of unexpected inflation (the residual from the time series model) at lag k . $\text{Corr}(u_t, CB_t)$ is the correlation of unexpected inflation with the quarterly return to a portfolio of long-term corporate bonds from 1947-78.

*Significant at 1% level.

**Significant at 5% level.

coefficients on inflation (α_1 , α_2 , and α_3), and the coefficients on IP_{t-j} and M_{t-k} are all zero, and if the coefficient on TB_t equals 1.0, then Fama's [1975] constant expected real rate of interest model is correct.

Table 3 contains estimates of (1) using the three different inflation series for the 1947-79 period. Most of the additional regressors have coefficients which are more than one standard error away from zero, and the estimates of the standard deviation of unexpected inflation, $S(u)$, are substantially lower than for the AR(3) models in Table 2. Since we view the regression in (1) as a type of reduced form, there is little point in trying to interpret the signs or magnitudes of the coefficients. Nevertheless, it is worth noting that both of the special cases, the univariate AR model and Fama's constant expected real rate of interest model, are rejected by these data. In addition, the F-tests for the stability of the regression coefficients between the 1947-63 and 1964-79 subperiods are relatively small, especially for the CPI inflation rate and the nondurable consumption deflator inflation rate, DEFN.

Given the results in Tables 2 and 3, it seems that the residuals from the multivariate prediction model (1) for the CPI inflation rate provide the best measure of unexpected inflation. The residual variance is low, the parameters of the model seem to be stable over the 1947-79 period, the residual autocorrelations are small, and the correlation of the unexpected CPI inflation rate with the return to the portfolio of corporate bonds is -.30. Thus, in the subsequent tests we use the

Table 3

Multivariate Models for Quarterly Inflation, 1947-79

Part A: Regression Models ^{a/}

$$\rho_t = \alpha_0 + \sum_{i=1}^3 \alpha_i \rho_{t-i} + \beta_1 \pi_t + \sum_{j=1}^2 \beta_2 j \pi_{t-j} + \sum_{k=1}^2 \beta_3 k \pi_{t-k} + u_t$$

Price Index	α_0	α_1	α_2	α_3	β_1	β_2	β_3	β_4	β_5	S(u)	F-test for Stability
CPI	-.0043 (.0013)	.362 (.073)	-.117 (.079)	.372 (.075)	.580 (.157)	.080 (.045)	.142 (.044)	.075 (.077)	-.075 (.078)	.0058	1.65
DEF	-.0026 (.0011)	.237 (.087)	.226 (.085)	.184 (.086)	.383 (.130)	.125 (.038)	.044 (.037)	.106 (.065)	-.071 (.067)	.0049	2.37*
DEFN	-.0034 (.0015)	.537 (.089)	-.020 (.099)	.115 (.090)	.480 (.177)	.137 (.052)	-.035 (.050)	-.115 (.089)	-.096 (.090)	.0067	.98

Part B: Summary Statistics for Unexpected Inflation, u_t

	r_1	r_2	r_3	r_4	r_5	r_6	r_7	r_8	S(r)	Corr(u_t, CB_t)
CPI	.01	.08	-.07	.09	.08	-.14	-.08	-.19	.09	-.30
DEF	-.05	.10	.01	-.02	.02	-.08	-.19	-.07	.09	-.20
DEFN	-.02	.05	.11	-.15	-.02	-.03	-.17	-.13	.09	-.22

^{a/} Standard errors are in parentheses. S(u) is the estimate of the standard deviation of unexpected inflation. The F-test for stability tests the hypothesis that all of the regression parameters are the same in the 1947-63 and 1964-79 subperiods, so the degrees of freedom are (9, 111). ρ_t is the quarterly inflation rate, π_t is the yield to maturity on a 3 month treasury bill which is known at the beginning of the quarter, π_{t-j} is the growth rate of the Index of industrial production for nondurable consumer goods in quarter t-j, and M_{t-k} is the growth rate of the monetary base in quarter t-k.

^{b/} r_k is the autocorrelation of unexpected inflation at lag k. Corr(u_t, CB_t) is the correlation of unexpected inflation with the quarterly return to a portfolio of long-term corporate bonds from 1947-78.

*Significant at the 5% level.

residuals from (1) for the CPI inflation rate to measure unexpected inflation, u_t , and the fitted values represent expected inflation, ρ_t^e .

By using fitted values and residuals from (1) as measures of expected and unexpected inflation we are using the entire sample period to provide estimates of the regression parameters, but the predicted inflation rates use only prior data.⁵ As long as the parameters of the regression model are stable over time, there should be no problem in using the entire sample period to estimate the parameters.

There is one additional issue which must be resolved before proceeding with the tests of the nominal contracting hypothesis. Unlike stock and bond prices which are measured on the last trading day of each measurement period, the prices of consumption goods which are used to measure inflation are not sampled frequently and they are not reported quickly. For example, the monthly CPI inflation rate contains price changes which occur over many previous months because some items are not sampled every month. Even the items which are sampled every month measure price changes from the middle of the previous month to the middle of this month, and to make things even more confusing, the CPI for January (for example) is not made public until the third week in February. Schwert [1981] uses daily returns to the Standard and Poor's Composite portfolio for the 1953-78 period to determine when the stock market reacts to the unexpected CPI inflation rate. His evidence suggests that most of the effect occurs around the date when the CPI is announced, which is after the month when the prices are sampled.

One of the reasons we use quarterly unexpected inflation rates in this paper is to mitigate some of the dating problems associated with price indices. Nevertheless, as a check on the dating of our inflation measures we compute the regression of quarterly corporate bond returns on one lead, one lag, and the current unexpected CPI inflation rate for the 1947-78 period,

$$CB_t = .0078 \quad -.280 \quad u_{t-1} \quad -1.535 \quad u_t \quad +.315 \quad u_{t+1} + \epsilon_t, \quad (2)$$

(.0026) (.437) (.435) (.438)

where standard errors are in parentheses. The contemporaneous coefficient is more than 3.5 standard errors below zero, but both the lead and lag coefficients are less than one standard error from zero. Given Schwert's [1981] results discussed above, we also consider an alternative measure of the quarterly return to corporate bonds which encompasses the announcement periods for the CPI. For example, the return to corporate bonds for the first quarter would include the returns for February, March, and April, instead of the usual January to March interval. Using this alternative measure of corporate bond returns, CB_t^* , to estimate the effects of current, one lead, and one lag of unexpected CPI inflation yields the following results,

$$CB_t^* = .0078 \quad -.183 \quad u_{t-1} \quad -.529 \quad u_t \quad -.714 \quad u_{t+1} + \epsilon_t. \quad (3)$$

(.0025) (.432) (.430) (.432)

It seems as though staggering the measurement interval for the corporate bond returns spreads the apparent effect of unexpected inflation out

over the current quarter and next quarter. In fact, the coefficient of next quarter's unexpected inflation rate, u_{t+1} , indicates that the current corporate bond return could be used to help forecast next period's inflation. Based on the results in (2) and (3) it seems appropriate to proceed with the tests of the nominal contracting hypothesis under the assumption that there are no dating problems in using the quarterly CPI unexpected inflation rate u_t .

4. Tests for Nominal Contracting Effects

A. The Data

To test the nominal contracting hypothesis, we would like a measure of the net monetary position of each of the firms in our sample. This measure, summarizing each firm's exposure to unexpected inflation, should reflect all nominal commitments, such as labor contracts, supply contracts, debt contracts, and pension commitments. Unfortunately, only a subset of these contracts is easily observable for most firms. We use the COMPUSTAT Annual Industrial file to obtain data on some of the major nominal contracts for a large set of firms. This computer tape contains yearly financial statement data from 1946 through 1979.

The task of measuring the firm's net monetary position is complicated by the different maturities of the various nominal contracts. The analysis in section 3 indicates that unexpected inflation is generally related to changes in future expected inflation. Hence, the value of long-term contracts will be more sensitive to unexpected inflation than the value of short-term contracts. One way to solve this problem is to specify some weighting scheme which can be used to combine nominal contracts with different maturities into one summary measure of the net monetary position of the firm. Instead, we segregate contracts into two groups by maturity. The short-term monetary position of the firm, SMP, includes all accounts which will be settled within the next year,

$SMP = \text{Cash} + \text{Accounts Receivable} - \text{Current Liabilities}.$

Similarly, the long-term monetary position, LMP, is the negative of the sum of the long-term debt and the preferred stock,

$LMP = - (\text{Long-term Debt} + \text{Preferred Stock}).$

Long-term debt includes all debt contracts with maturities of more than one year. Preferred stock is a perpetuity unless the firm liquidates. There is a complication with many debt and preferred stock contracts: they are often convertible into common stock, which means that part of the value of these contracts is not related to the promised future nominal payouts. This will reduce the effective maturity of these contracts in terms of the effects of unexpected inflation; however, since COMPUSTAT does not contain enough information to adjust for the effect of convertibility we ignore this issue in our tests.

Another nominal contract which can be measured using COMPUSTAT data is the tax shield provided by depreciation. As noted in section 2, depreciation expenses are based on historical costs, rather than replacement costs. Since these expenses reduce the firm's tax payments, the claim to these depreciation tax shields is a nominal contract with the government. Unexpected inflation reduces the real value of the tax shields and redistributes wealth from the firm to the government.

The depreciation tax shield is easy to measure for years from 1947 through 1954 because firms were required to use straight-line depreciation for tax purposes and they typically used the same technique for financial reporting. However, starting in 1954 firms were allowed to use accelerated

depreciation for tax purposes, but they were not required to use the same technique for financial reporting. Since COMPUSTAT contains financial statement data, the nominal tax shields cannot be measured directly using the depreciation data alone. Nevertheless, it is possible to estimate the depreciation tax shields after 1955 using the following algorithm:⁶

- (1) if a firm uses different depreciation methods for tax and book purposes, it generally reports the difference between the tax liability which is implied by the book method (the tax expense, TE) and the actual tax payments which result from using the tax depreciation method (taxes paid, TP) as a credit to the deferred tax account, DT.
- (2) assuming that the change in the deferred tax account arises solely because of the different depreciation methods, we can infer the firm's depreciation for tax purposes

$$\begin{aligned}
 DT_t - DT_{t-1} &= TE_t - TP_t \\
 &= (NI_t - d_B) \tau - (NI_t - d_T) \tau \\
 &= \tau (d_T - d_B) ,
 \end{aligned} \tag{4}$$

where NI is net income before depreciation and taxes, d_B is book depreciation, d_T is tax depreciation, and τ is the marginal corporate tax rate. Rearranging (4) yields

$$d_T = d_B + \frac{DT_t - DT_{t-1}}{\tau} . \tag{5}$$

Thus, the future nominal tax shields in year t , TAX_t , are found by adjusting the plant and equipment account, PE_t , for the accumulated difference between book and tax depreciation since 1954,

$$\begin{aligned} \text{TAX}_t &= \text{PE}_t + \sum_{i=1955}^t (d_{B_i} - d_{T_i}) \\ &= \text{PE}_t + \sum_{i=1955}^t \frac{(\text{DT}_i - \text{DT}_{i-1})}{\tau} \end{aligned} \quad (6)$$

Assuming that the marginal tax rate equals 50% over the sample period, equation (6) simplifies to

$$\text{TAX}_t = \text{PE}_t + 2\text{DT}_t, \quad (7)$$

where DT_t is the level of the deferred tax account in year t . The maturity structure of the nominal tax shields depends on the ages of the underlying assets. In addition, if the tax laws are revised in response to changes in expected inflation (e.g., the investment tax credit would reduce current tax rates for firms which are buying future tax shields), as Fama [1979] suggests, this will tend to reduce the effect of unexpected inflation on the value of these nominal contracts. Nevertheless, we would expect the tax shields, TAX , to have a maturity structure between the long-term monetary position, LMP , and the short-term monetary position, SMP , for most firms.

There is one final problem which introduces errors into the measurement of the monetary position of different firms. It would be preferable to have data on the market values of all of the nominal contracts, but COMPUSTAT only contains data on book values, and it would be expensive to collect the data on market values even for the subset of nominal

contracts which are publicly traded. Fortunately, Freeman [1978] compares book and market value measures of monetary position for a reasonably large set of firms and finds that they are highly correlated.

A sample of firms from the COMPUSTAT tape is constructed for each quarter from 1947 through 1979 subject to the following criteria:

- (a) a firm is included in a given quarter if it has data available on all of the accounting variables used to measure the monetary position from the previous fiscal year (Cash, Accounts Receivable, Current Liabilities, Long-term Debt, Preferred Stock, Plant and Equipment, and Deferred Taxes);
- (b) the firm has to have data available on the number of shares of common stock outstanding and the year-end market price so that the value of the equity at the beginning of the quarter, S_{t-1} , can be computed;
- (c) the firm has to have stock return data available in that quarter from the CRSP Monthly File (from the Center for Research in Security Prices, University of Chicago).

The number of firms in the sample varies from a low of 328 in 1947 to a high of 1184 in 1972, and 158 firms have data available for every quarter.

B. Seemingly Unrelated Regression Tests

To measure the comovements of stock returns with unexpected inflation we use the time series regression model

$$R_{it} = \gamma_{0i} + \gamma_{1i}\rho_t^e + \gamma_{2i}u_t + \epsilon_{it}, \quad t=1, \dots, T, \quad (8)$$

where R_{it} is the quarterly return to stock i , ρ_t^e is the expected CPI

inflation rate from the model in Table 3, and u_t is the unexpected CPI inflation rate. The coefficient of unexpected inflation in (8), γ_{2i} , measures the comovement of stock returns from firm i with unexpected inflation. The expected inflation rate is included in (8) because Fama and Schwert [1977] have documented a negative relationship between stock returns and expected inflation over the 1953-75 period. Note that ρ_t^e and u_t are uncorrelated by construction, so the least squares estimator of γ_{2i} is unaffected by the inclusion of ρ_t^e in (8). The reason for including expected inflation in (8) is to control for variation in stock returns that is not related to unexpected inflation to increase the power of the tests. In terms of the model in (8), the effect of expected inflation represents movement of ex ante expected stock returns through time, while the effect of unexpected inflation represents the ex post revaluation of stocks due to the new information about inflation.

Table 4 contains estimates of (8) for the Ibbotson-Sinquefield [1979] portfolio of corporate bonds, CB_t , and for the value-weighted portfolio of New York Stock Exchange (N.Y.S.E.) common stocks, R_{mt} , for several time periods. The results for corporate bond returns in Part A show that unexpected inflation has a negative effect on corporate bond returns over the 1947-78 period, with the strongest effect occurring in the 1964-78 subperiod (when $\gamma_{2i} = -3.2$ with a t-statistic of -3.7). It seems that the ex ante returns to corporate bonds are not substantially affected by expected inflation since the estimates of γ_{1i} are not statistically different from zero.⁷

Table 4

Effects of Expected and Unexpected Inflation on
Quarterly Corporate Bond and Common Stock Returns, 1947-1979^{a/}

$$R_{it} = \gamma_{0i} + \gamma_{1i}p_t^e + \gamma_{2i}u_t + \epsilon_{it}, t=1, \dots, T$$

Period	Sample Size, T	γ_{0i}	γ_{1i}	γ_{2i}	$S(\epsilon_i)$	R^2
Part A. Corporate Bond Returns, $R_{it} = CB_t^{b/}$						
1947:4 - 1978:4	125	.0069 (.0040)	.067 (.327)	-1.521 (.433)	.0286	.090
1947:4 - 1963:4	65	.0089 (.0036)	-.645 (.523)	-.730 (.408)	.0221	.069
1964:1 - 1978:4	60	.0018 (.0102)	.461 (.646)	-3.168 (.867)	.0330	.181
1953:1 - 1971:2	74	.0060 (.0057)	-.359 (.737)	-2.515 (.893)	.0295	.103
Part B. Common Stock Returns, $R_{it} = R_{mt}^{c/}$						
1947:4 - 1979:4	129	.0446 (.0104)	-2.299 (.854)	-.121 (1.132)	.0749	.054
1947:4 - 1963:4	65	.0499 (.0098)	-4.109 (1.440)	2.576 (1.123)	.0607	.181
1964:1 - 1979:4	64	.0284 (.0252)	-1.113 (1.597)	-5.711 (2.143)	.0814	.116
1953:1 - 1971:2	74	.0571 (.0134)	-5.377 (1.732)	-3.132 (2.099)	.0694	.122

^{a/}Standard errors in parentheses. The data start in the fourth quarter of 1947 (1947:4) because three lags of inflation are used in Table 3 to estimate expected and unexpected inflation, p_t^e and u_t . $S(\epsilon_i)$ is the standard deviation of the residuals and R^2 is the coefficient of determination.

^{b/}Quarterly rate of return to a portfolio of long-term corporate bonds from Ibbotson and Sinquefeld [1979]. These data are not available for 1979.

^{c/}Quarterly return to the value-weighted portfolio of New York Stock Exchange stocks from the Center for Research in Security Prices (CRSP).

The results for the stock portfolio R_{mt} in Part B of Table 4 show the negative effect of expected inflation on ex ante stock returns, since γ_{1i} is negative in all of the periods reported, and the estimates are more than two standard errors below zero in all periods except 1964-79. The effects of unexpected inflation on the aggregate portfolio of stocks are less regular. For the 1947-63 subperiod, the estimate of γ_{2i} is more than two standard errors above zero, suggesting that the N.Y.S.E. firms as a group benefitted from unexpected inflation in this period. However, in the 1964-79 and 1953-71 subperiods the effect of unexpected inflation is negative and the estimate of γ_{2i} is more than two standard errors below zero in the 1964-79 period. For the overall 1947-79 period the estimate of the coefficient of unexpected inflation, γ_{2i} , is small and not significantly different from zero. Thus, while unexpected inflation was generally bad for bondholders throughout the 1947-78 period, there is some evidence that unexpected inflation had a changing effect on stockholders within the 1947-79 period, perhaps due to a changing structure of nominal contracts. The tests below provide a detailed look at this issue.

The nominal contracting hypothesis says that ceteris paribus the sensitivity of stock returns to unexpected inflation, γ_{2i} , should be more negative: (a) the larger the long-term monetary position, LMP_i , (b) the larger the nominal tax shields, TAX_i , and (c) the larger the short-term monetary position, SMP_i , because unexpected inflation reduces the value of these nominal assets.⁸ To represent this hypothesis, write

the coefficient of unexpected inflation for firm i as a function of the monetary position variables,

$$\gamma_{2i,t} = a_{0i} + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right), \quad (9)$$

where $S_{i,t-1}$ is the value of the stock of firm i in period $t-1$. Since γ_{2i} represents the effect of unexpected inflation on the return to the stock of firm i (i.e., the change in the stock price divided by $S_{i,t-1}$), dividing the monetary position variables by $S_{i,t-1}$ puts all of the variables in the same units of measurement. The coefficient of the long-term monetary position, a_1 , measures the effect of unexpected inflation on the value of these long-term contracts. Likewise, a_2 and a_3 represent the effects of unexpected inflation on the value of the nominal tax shields and the short-term monetary position, respectively. By examining these three components of the firm's nominal contract position separately it is possible to let the data determine how to weight the different maturity structures and provisions of these contracts. Estimating a_1 , a_2 , and a_3 avoids the problem of combining these categories into a single measure of the monetary position of the firm.⁹

Thus, equation (9) can be substituted into (8) to allow the sensitivity of unexpected inflation to vary as the nominal contract position of firm i changes over time

$$R_{it} = \gamma_{0i} + \gamma_{1i} \rho_t^e + \left[a_{0i} + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right) \right] u_t + \epsilon_i$$

$$\begin{aligned}
 = & \gamma_{0i} + \gamma_{1i} \rho_t^e + a_{0i} u_t + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) u_t + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) u_t \\
 & + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right) u_t + \epsilon_{it}, \quad t=1, \dots, T.
 \end{aligned} \tag{10}$$

Assuming that the effects of unexpected inflation on the value of nominal contracts are the same for all firms, the coefficients a_1 , a_2 , and a_3 should be the same for different firms, and a pooled time series-cross sectional approach can be used to estimate (10). This is important because there may not be much variation in the relative monetary position variables $(LMP_{i,t-1}/S_{i,t-1})$, $(TAX_{i,t-1}/S_{i,t-1})$, and $(SMP_{i,t-1}/S_{i,t-1})$ over time for a given firm i , but there is probably substantial variation in these variables across firms.

If the time series regression equations in (10) for N different firms are estimated as a system of equations, the parameters a_1 , a_2 , and a_3 can be estimated directly by imposing the linear restriction that these parameters are constant across firms for $i=1, \dots, N$. This technique is a straight-forward application of Zellner's [1962] seemingly unrelated regression (SUR) technique. Recent applications of this methodology to financial models include Gibbons [1981], Hess [1981], and Stambaugh [1981].

There is one limitation of the SUR model which must be dealt with before carrying out the tests of the nominal contracting hypothesis:

the number of firms (time series regression equations) must be less than the number of time series observations, $N < T$. There are at most 129 quarterly observations to use since 3 observations are lost by using lagged inflation rates to model expected inflation. Therefore, the number of stocks which can be analyzed at one time is less than 129. In fact, since the SUR estimation technique requires inverting the $N \times N$ covariance matrix of time series regression disturbances, the practical limit on the number of equations is much smaller.¹⁰

1. Sequentially Updated Portfolios

One way to reduce the number of equations is to use the returns to portfolios of stocks to estimate the time series regression models in (10). It is important to form the portfolios in a way that creates dispersion in the values of the monetary position variables so that the estimates of a_1 , a_2 , and a_3 are as precise as possible. Accordingly, if there are N firms with data available for the first quarter of 1947, the firms are first sorted into one of three equal-size groups (high (H), medium (M), or low (L)) depending on the level of the long-term monetary position variable, $(LMP_{i,t-1}/S_{i,t-1})$. Next, within each of the long-term monetary position groups the firms are sorted into three equal-size groups based on the nominal tax shield variable $(TAX_{i,t-1}/S_{i,t-1})$. Finally, within each of the previous nine groups the firms are sorted into three equal-size groups based on the short-term monetary position variable, $(SMP_{i,t-1}/S_{i,t-1})$. Thus, this sequential sorting procedure yields 27 portfolios with different characteristics

concerning the three monetary position variables ranging from (H,H,H) which represents high levels of all three variables through (L,L,L) representing low levels of all three monetary position variables.

The sorting is updated every quarter based on data available for the most recent fiscal year. As a result of this updating process the composition of the 27 portfolios changes over time for two reasons: first, the relative rankings of firms change as new data become available; second, new firms are added to the sample as they meet the data requirements and old firms drop from the sample if they fail to meet data requirements. Table 5 contains the sample means and standard deviations of the monetary position variables for the 27 portfolios for the 1947-79 period. It is apparent from Table 5 that some of the extreme portfolios have very volatile levels of the monetary position variables, and that there is substantial variation across these 27 portfolios. For example, the firms with lots of debt seem to have lots of tax shields (the (L,H,.) portfolios).

Table 6 contains estimates of the monetary position coefficients a_1 , a_2 , and a_3 in (10) from the seemingly unrelated regression using the 27 sequentially updated portfolios. Table 6 also contains F-tests of the cross-sectional restrictions that the monetary position coefficients are constant across portfolios (e.g., $a_{1i} = a_1$ for $i = 1, \dots, 27$). Since almost all of these F-tests reject the hypothesis of constant coefficients for all of the time periods reported, the estimates of a_1 , a_2 , and a_3 should only be interpreted as measuring the average effect of the monetary

Table 5

Means and Standard Deviations of Monetary Position Variables
for 27 Sequentially Updated Portfolios, 1947-79

	$\left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right)$		$\left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right)$		$\left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right)$	
Portfolio ^{a/}	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
(H,H,H)	-.048	.045	.599	.163	.305	.104
(H,H,M)	-.062	.054	.549	.130	.092	.053
(H,H,L)	-.062	.053	.557	.130	-.133	.138
(H,M,H)	-.043	.037	.244	.073	.254	.089
(H,M,M)	-.052	.041	.241	.075	.081	.041
(H,M,L)	-.055	.043	.242	.074	-.057	.057
(H,L,H)	-.028	.023	.094	.033	.273	.109
(H,L,M)	-.027	.012	.101	.036	.075	.038
(H,L,L)	-.032	.018	.099	.039	-.044	.060
(M,H,H)	-.353	.180	.875	.246	.257	.079
(M,H,M)	-.350	.187	.864	.260	.069	.057
(M,H,L)	-.345	.193	.930	.282	-.174	.153
(M,M,H)	-.309	.167	.481	.165	.298	.116
(M,M,M)	-.283	.140	.490	.169	.086	.057
(M,M,L)	-.292	.159	.484	.167	-.123	.127
(M,L,H)	-.282	.133	.240	.091	.325	.122
(M,L,M)	-.242	.117	.255	.108	.087	.040
(M,L,L)	-.263	.136	.250	.088	-.259	.463
(L,H,H)	-1.842	1.275	2.142	.881	.435	.280
(L,H,M)	-1.389	.888	2.055	.950	.044	.154
(L,H,L)	-2.036	1.383	2.491	1.048	-.525	.605
(L,M,H)	-1.091	.627	.988	.398	.442	.152
(L,M,M)	-.857	.451	.997	.419	.114	.095
(L,M,L)	-1.005	.638	1.007	.422	-.260	.273
(L,L,H)	-1.411	.771	.307	.177	1.421	.542
(L,L,M)	-.762	.401	.503	.218	.196	.105
(L,L,L)	-1.022	.775	.454	.193	-.372	.614

^{a/} These symbols represent different levels of the monetary position variables, for example (H,M,L) represents high levels of long-term monetary position, medium levels of tax shields, and low levels of short-term monetary position.

position variables on the sensitivity of stock returns to unexpected inflation.

Nevertheless, the estimates of a_1 , a_2 , and a_3 in Table 6 are disturbingly contrary to the nominal contracting hypothesis. For example, if the nominal contracting hypothesis is valid, stockholders of firms with a lot of long-term debt should be benefitted by unexpected inflation. Since the long-term monetary position variable is defined so that firms with a lot of debt will have substantially negative values for $(LMP_{i,t-1}/S_{i,t-1})$, this implies that a_1 should be negative. Similar analysis indicates that a_2 and a_3 should also be negative. Further, these coefficients should not be contaminated by "information effects" associated with unexpected inflation, since a_{0i} is allowed to vary across portfolios and is not a function of the nominal contracting position. Considering all four time periods in Table 6, there is only one parameter estimate which is more than two standard errors below zero - the coefficient of short-term monetary position, a_3 , for the 1964-79 subperiod. On the other hand, there are four estimates which are more than two standard errors above zero. Given the seemingly nonsensical estimates in Table 6 (e.g., the estimate of $a_1 = 6.5$ for the 1953-71 subperiod implies that stockholders of firms with more long-term debt actually suffered substantially greater losses as a result of unexpected inflation than stockholders of firms with less debt), it is not worth considering some of the more refined hypotheses about the effects of maturity discussed earlier (e.g., the maturity effect ought to cause $-a_1 > -a_2 > -a_3$).

Table 6

SUR Tests of the Nominal Contracting Hypothesis Using Sequentially Updated Portfolios^{a/}

$$R_{it} = \gamma_{0i} + \gamma_{1i} p_t^e + a_{0i} u_t + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) u_t + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) u_t + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right) u_t + \epsilon_{it}$$

$$t=1, \dots, T; \quad i=1, \dots, 27$$

Period	Sample Size, T	a_1	F-statistic ^{c/} $a_{1i}=a_1$	a_2	F-statistic ^{d/} $a_{2i}=a_2$	a_3	F-statistic ^{e/} $a_{3i}=a_3$	F-statistic ^{f/} $a_{1i}=a_1, a_{2i}=a_2, a_{3i}=a_3$
1947:4 - 1979:4	129	.601 (.550)	2.39	.328 (.711)	2.80	-.224 (.396)	2.54	2.44
1947:4 - 1963:4	65	-.027 (.929)	2.26	.897 (.978)	3.09	2.845* (1.048)	2.38	2.26
1964:1 - 1979:4	64	1.552* (.775)	3.87	-.831 (1.118)	3.84	-1.084* (.487)	5.87	3.79
1953:1 - 1971:2	74	6.509* (1.742)	2.40	2.942 (2.029)	2.31	7.357* (1.983)	1.52	2.35

^{a/} Asymptotic standard errors in parentheses. The coefficient of unexpected inflation is assumed to take the form

$$\gamma_{2i} = a_{0i} + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right)$$

where a_{0i} represents effects which are allowed to differ across the 27 portfolios, a_1 measures the effect of Long-term Monetary Position, a_2 measures the effect of Tax shields, and a_3 measures the effect of Short-term Monetary Position. The 27 portfolios are created by allocating all firms with data for a given quarter to a portfolio based on rankings of LMP, TAX, and SMP.

^{b/} The data start in the fourth quarter of 1947 (1947:4) because three lags of inflation are used in Table 3 to estimate the expected and unexpected inflation, p_t^e and u_t .

^{c/} This statistic tests the hypothesis that $a_{1i}=a_1$ for $i=1, \dots, 27$. Note that a_1 is the point estimate under the constraint that this coefficient is the same for all 27 portfolios.

^{d/} This statistic tests the hypothesis that $a_{2i}=a_2$ for $i=1, \dots, 27$.

^{e/} This statistic tests the hypothesis that $a_{3i}=a_3$ for $i=1, \dots, 27$.

^{f/} This statistic tests the hypothesis that $a_{1i}=a_1$, $a_{2i}=a_2$, and $a_{3i}=a_3$ for $i=1, \dots, 27$. This and the test statistics described in footnotes c to e have asymptotic F-distributions. For testing the constancy of one coefficient across equations, the test has 26 and 27*(T-6) degrees of freedom. The test of all three constraints has 78 and 27*(T-6) degrees of freedom.

*More than two standard errors from zero.

The poor results in Table 6 suggest that it is not possible to use the data from published financial statements to predict wealth transfers from unexpected inflation. However, before abandoning hope it is worthwhile to consider some alternative strategies for testing the nominal contracting hypothesis to insure that the negative results are not a result of faulty statistical analysis.

2. Fixed Portfolios

There is a potential problem with using the seemingly unrelated regression technique on a set of portfolios which changes composition over time: the SUR technique assumes that the $N \times N$ contemporaneous covariance matrix of regression disturbance terms, Σ , is constant over time and, since a given firm will not generally stay in the same portfolio in all time periods, it seems unlikely that Σ is actually constant through time.¹¹

One way to solve this problem is to construct portfolios which do not change composition over time. There are 158 firms which have data for the entire 1947-79 period, so we sort these firms into 27 portfolios based on their monetary position variables, LMP, TAX, and SMP, as measured at the middle of the time period, the second quarter of 1963. Of course, there is less dispersion in the monetary position variables across portfolios, especially in the time periods far distant from the period when the sorting occurs. Also, since we require firms to have data for the entire 1947-79 period, this sample has a disproportionate number of large firms.¹²

Nevertheless, if the covariance matrix of regression disturbances from (10) is stationary for individual stocks, these fixed composition portfolios will also have a stationary covariance matrix, and it is legitimate to use the SUR technique to estimate the effects of nominal contracting.

Table 7 contains estimates of (10) for the 27 fixed composition portfolios described above. There are several notable differences between the results in Table 7 and the results in Table 6. First, the estimates of the long-term monetary position coefficient, a_1 , are negative for all of the time periods in Table 7, although the biggest t-statistic is only -1.7 for the 1947-63 subperiod. Second, the F-statistics which test the restrictions that the monetary position coefficients are constant across portfolios are generally smaller in Table 7 than in Table 6, which eliminates some of the ambiguity in interpreting the restricted estimates a_1 , a_2 , and a_3 . In fact, for the 1947-63 subperiod and for the overall 1947-79 period the F-tests are all less than 1.85. Third, for the 1947-63 and 1953-71 subperiods the estimate of the nominal tax shields coefficient, a_2 , is negative, and it is more than three standard errors below zero in the 1953-71 subperiod. This suggests that unexpected inflation caused wealth transfers from firms with tax shields to the government in these periods. Finally, however, the estimates of the short-term monetary position coefficient, a_3 , are positive in all time periods, and they are more than three standard errors above zero in the 1947-63 and 1953-71 subperiods.

Table 7

SUR Tests of the Nominal Contracting Hypothesis Using Fixed Portfolios^{a/}

$$R_{it} = \gamma_{0i} + \gamma_{1i}p_t^e + a_{0i}u_t + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) u_t + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) u_t + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right) u_t + \epsilon_{it}$$

t=1,...,T; i=1,...,27

Period ^{b/}	Sample Size, T	a ₁	F-statistic ^{c/} a ₁₁ =a ₁	a ₂	F-statistic ^{d/} a ₂₁ =a ₂	a ₃	F-statistic ^{e/} a ₃₁ =a ₃	F-statistic ^{f/} a ₁₁ =a ₁ , a ₂₁ =a ₂ , a ₃₁ =a ₃
1947:4 - 1979:4	129	.190 (.537)	1.57	.399 (.768)	1.55	1.651 (.922)	1.84	1.80
1947:4 - 1963:4	65	-3.008 (1.796)	1.14	-2.045 (1.651)	1.45	4.668* (1.565)	1.61	1.71
1964:1 - 1979:4	64	.210 (.837)	2.52	1.070 (1.296)	2.25	.931 (1.326)	2.79	2.52
1953:1 - 1971:2	74	-2.326 (1.807)	2.38	-7.890* (2.322)	2.89	9.471* (2.911)	2.29	2.88

^{a/} Asymptotic standard errors in parentheses. The coefficient of unexpected inflation is assumed to take the form

$$\gamma_{2i} = a_{0i} + a_1 \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) + a_2 \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) + a_3 \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right)$$

where a_{0i} represents effects which are allowed to differ across the 27 portfolios, a_1 measures the effect of Long-term Monetary Position, a_2 measures the effect of Tax shields, and a_3 measures the effect of Short-term Monetary Position. The 27 portfolios are created by ranking the 158 firms with data available for the entire 1947-79 period into equal-size groups based on rankings of LMP, TAX, and SMP, using data for the second quarter of 1963 (1963:2) to create the rankings. The composition of the portfolios does not change over time.

^{b/} The data start in the fourth quarter of 1947 (1947:4) because three lags of inflation are used in Table 3 to estimate expected and unexpected inflation, p_t^e and u_t .

^{c/} This statistic tests the hypothesis that $a_{1i}=a_1$ for $i=1, \dots, 27$. Note that a_1 is the point estimate under the constraint that this coefficient is the same for all 27 portfolios.

^{d/} This statistic tests the hypothesis that $a_{2i}=a_2$ for $i=1, \dots, 27$.

^{e/} This statistic tests the hypothesis that $a_{3i}=a_3$ for $i=1, \dots, 27$.

^{f/} This statistic tests the hypothesis that $a_{1i}=a_1$, $a_{2i}=a_2$, and $a_{3i}=a_3$ for $i=1, \dots, 27$. This and the test statistics described in footnotes c to e have asymptotic F-distributions. For testing the constancy of one coefficient across equations, the test has 26 and 27 (T-6) degrees of freedom. The test of all three constraints has 78 and 27 (T-6) degrees of freedom.

*More than two standard errors from zero.

Thus, while some of the results in Table 7 with the fixed composition portfolios are consistent with the nominal contracting hypothesis, many of the estimates are inconsistent with the wealth redistributions which should occur as a result of unexpected inflation. It is also difficult to totally dismiss the results in Table 6, since the purported statistical problem (the nonconstant covariance matrix of disturbances) should only affect the significance tests and the efficiency of the estimators--it should not bias the coefficient estimators. In fact, the biggest reason for the difference between the results in Table 6 and the results in Table 7 is probably the more limited set of firms used in Table 7.

3. Using Corporate Bond Returns to Estimate Wealth Transfers

As discussed earlier, tests of wealth redistributions as a result of unexpected inflation are only as good as the measure of unexpected inflation. Section 3 considers a variety of measures of unexpected inflation and one of the criteria used to select the best measure was the correlation of unexpected inflation with the return to the Ibbotson-Sinquefeld [1979] corporate bond portfolio, CB_t . The premise of that criterion is that a loss to corporate bondholders ought to be a gain for stockholders. Following that logic even further, we replicate the tests in Tables 6 and 7 using CB_t instead of the unexpected inflation rate u_t in (10).

Table 8 contains estimates of the coefficients of the monetary position variables using both the sequentially updated and the fixed

composition portfolios. Note, however, that the coefficients a_1 , a_2 , and a_3 are multiplied by -1 in Table 8 to make them comparable to the results in Tables 6 and 7, since unexpected inflation, $u_t > 0$, should be associated with negative bond returns, $CB_t < 0$.

In general, the results for the updated portfolios are even worse in Table 8 than they are in Table 6, since all but one of the coefficient estimates are positive, and three of the estimates are more than two standard errors above zero. For example, a literal interpretation of the estimate of the coefficient of long-term monetary position, a_1 , for the 1947-79 period would be that a 1% loss to bondholders would be associated with a .17% loss to stockholders if the debt/equity ratio is 1. Instead of a wealth transfer, it seems that there is some phenomenon which affects both bond and stock returns in the same direction which dominates the wealth transfer.¹³

The results in Table 8 for the fixed composition portfolios are comparable to the results in Table 7 in the sense that at least some of the estimates of the monetary position coefficient have negative signs. In fact, in the 1947-63 subperiod all three coefficients have negative signs, although only the tax shield estimate is more than two standard errors below zero. Again, however, there are some conflicting results which do not support the nominal contracting hypothesis; in particular, in the 1953-71 subperiod both the long-term and short-term monetary position coefficients are more than two standard errors above zero.

SUR Tests of the Nominal Contracting Hypothesis

Analyzing the Effect of Corporate Bond Returns $\frac{a}{a/}$

$$R_{it} = \gamma_{0i} + \gamma_{1i} \rho_t^e + a_{0i} CB_t + a_{1i} \left(\frac{LMP_{i,t-1}}{S_{i,t-1}} \right) CB_t + a_{2i} \left(\frac{TAX_{i,t-1}}{S_{i,t-1}} \right) CB_t + a_{3i} \left(\frac{SMP_{i,t-1}}{S_{i,t-1}} \right) CB_t + \epsilon_{it}$$

t = 1, ..., T; i = 1, ..., 27

Period $\frac{b}{b/}$	Sample Size, T	Sequentially Updated Portfolios $\frac{c}{c/}$			Fixed Portfolios $\frac{d}{d/}$		
		$\frac{-a_1}{-a_1}$	$\frac{-a_2}{-a_2}$	$\frac{-a_3}{-a_3}$	$\frac{-a_1}{-a_1}$	$\frac{-a_2}{-a_2}$	$\frac{-a_3}{-a_3}$
1947:4-1979:4	129	.168* (.077)	.175 (.110)	.145* (.062)	.000 (.081)	-.068 (.121)	.148 (.173)
1947:4-1963:4	65	.113 (.372)	.667 (.394)	.494 (.377)	-1.104 (.648)	-1.438* (.582)	-.211 (.533)
1964:1-1979:4	64	.043 (.077)	.103 (.109)	.103 (.057)	-.079 (.098)	.054 (.145)	.623* (.201)
1953:1-1971:2	74	.646* (.199)	.487 (.248)	-.019 (.228)	.703* (.204)	-.188 (.267)	.900* (.412)

$\frac{a}{a/}$ Asymptotic standard errors in parentheses. These regressions are similar to the estimates in Tables 6 and 7, except the rate of return to a portfolio of long-term corporate bonds, CB_t , is used instead of the unexpected inflation rate, u_t , to measure the wealth redistribution effects. In order to make these results comparable to the results in Tables 6 and 7, the estimates of a_1 , a_2 , and a_3 are multiplied by -1, since a positive unexpected inflation rate should correspond to a negative corporate bond return.

$\frac{b}{b/}$ The data start in the fourth quarter of 1947 (1947:4) because three lags of inflation are used in Table 3 to estimate expected and unexpected inflation, ρ_t^e and u_t .

$\frac{c}{c/}$ See results in Table 6 for comparison.

$\frac{d}{d/}$ See results in Table 7 for comparison.

*More than two standard errors from zero.

5. Alternative Tests for Nominal Contracting Effects

In addition to the tests reported in Tables 6, 7, and 8, we have performed a number of additional tests to see whether the financial contract data available on COMPUSTAT can be used to detect effects of nominal contracting on stock returns. Since the additional tests yield results which are similar to the results reported above, we omit detailed reporting of these tests. Nevertheless, it is useful to know that a variety of different test specifications are equally unable to detect the predicted effects of nominal contracting.

Most firms are involved in a wide range of nominal contracts besides those we examine in the tests above. For example, firms subject to price regulation have an implicit contract with the consumers of their products. Because of this nominal contract, these firms are hurt by unexpected inflation, especially if "regulatory lag" causes regulated prices to adjust slowly to inflation.

Omitting the nominal regulatory contracts will not necessarily cause problems in the tests above. However, if these contracts are correlated with the included contracts, the results will be biased. For example, public utilities appear to have relatively large proportions of long-term debt and preferred stock in their capital structures. If this is true, omitting their regulatory contracts will tend to bias the coefficients in our tests against the nominal contracting hypothesis.

To check this possibility, we replicate the tests in Tables 6, 7, and 8, excluding firms in the railroad, trucking, airline, telephone,

and natural gas industries.¹⁴ A total of 93 firms are excluded, but none of the results changed in a substantive way. In addition, we estimate the effects of unexpected inflation on portfolios involving only regulated firms and, again, the results do not support the nominal contracting hypothesis. In short, it does not seem that exclusion of product price nominal contracts from the previous tests can explain the failure to support the nominal contracting hypothesis.

Another issue worth considering is the hypothesis in (9) which says that the effect of unexpected inflation on stock returns, γ_{2i} , is linearly related to the size of the contract relative to the value of the stock. While this proposition is reasonable, the relationship may not be the same for all firms. For example, firms with different maturity structures for the long-term monetary position variable should have different coefficients for $(LMP_{i,t-1}/S_{i,t-1})$ in (9). This does not cause a problem as long as the differences in coefficients across portfolios are not related to the magnitudes of the nominal contract variables.

Nevertheless, as a check on the validity of the tests in Tables 6, 7, and 8, we compare the coefficients of unexpected inflation in (8) for portfolios with different levels of the monetary position variables. For example, the coefficient of unexpected inflation, γ_{2i} , is constrained to be the same for all portfolios with high levels of the long-term monetary position variable and for all portfolios with low levels of that variable. Under the nominal contracting hypothesis γ_{2i} is more

negative for the high LMP portfolios than the low LMP portfolios. We perform these paired comparison tests for each of the monetary position variables and none of them show a significant difference. Thus, it does not seem that the results of the tests reported above are dependent on the model in (9) for the effect of unexpected inflation on stock returns.

6. Conclusions

This paper analyzes the effects of unexpected inflation on the stock returns of firms with different monetary positions. A major improvement over most previous work along these lines is that we carefully distinguish between the effects of expected and unexpected inflation in our tests. The main conclusion is that there is no strong support for the nominal contracting hypothesis. It does not seem that firms which have relatively large net monetary liabilities benefitted from unexpected inflation relative to firms with net monetary assets during the 1947-79 period. This result is surprising, to say the least, since the purported distributive effects of unexpected inflation are so well-known that they have been the source of numerous journal articles (see for example Bradford [1974], Budd and Seiders [1971], Kaplan [1977], Nelson [1976b], and Van Horne and Glassmire [1972], in addition to the papers previously mentioned).

Since the results are so counterintuitive, we perform a variety of tests to verify that the statistical analysis is not sensitive to the specification of the variables or the sample period. Several measures of quarterly unexpected inflation are used, different types of nominal contracts are used, and different sample periods are used. The seemingly unrelated regression technique is used to produce pooled time series-cross sectional tests of the nominal contracting hypothesis. Given the variety of tests used in this paper it is difficult to believe that there is a simple statistical explanation for our failure to support the nominal contracting hypothesis.

There is at least one explanation which is consistent with the results in this paper: Modigliani and Cohn [1979] claim that stockholders do not understand the effect of inflation on the value of nominal debt contracts. We are reluctant to accept the hypothesis that stockholders and bondholders (who may be the same people) have differential ability to understand the effects of inflation. Nevertheless, the results in this paper certainly do not contradict the Modigliani-Cohn Hypothesis.

In our minds there are two more likely reasons why the data yield such murky results. First, it could be that there are so many other things which affect the value of common stocks that the variability of other effects swamps the apparently small wealth redistributions caused by unexpected inflation. In other words, the variance of quarterly stock returns is so large relative to the variance of unexpected inflation that it is difficult to detect differential effects of unexpected inflation by examining stock returns.

A second possible explanation is that published financial statements only contain a subset of nominal contracts, so our tests do not include data on nominal contracts for raw materials, labor, pensions, final products, and so forth. If stockholders desire to hedge against unexpected inflation, firms could construct a set of contracts for inputs and outputs which would leave the value of the stock unaffected by unexpected inflation. For example, even though the stockholders would benefit because the value of the debt falls, they would lose if the firm has a contract to sell its product at a fixed price in the future.

If there was a general tendency for firms to hedge in this way, tests such as ours would not support the nominal contracting hypothesis because there would be no relationship between a subset of contracts and the sensitivity of stock returns to unexpected inflation.¹⁵ Without more detailed data on the structure of nominal contracts for individual firms it seems unlikely that this problem can be resolved.¹⁶

Footnotes

1. Freeman [1978], Fama [1979] and Gonedes [1980] argue that changes in the tax law have reduced tax rates in periods of high inflation. Nevertheless, the tax code is adjusted at most once a year, so these changes in tax laws could not eliminate redistributinal effects of unexpected inflation over shorter time intervals.
2. Box and Jenkins [1976] describe the use of autoregressive-integrated-moving average (ARIMA) models.
3. If relevant variables are omitted from the model for unexpected inflation, the least squares estimator of the regression coefficient of stock returns on unexpected inflation will be biased toward zero. This problem would reduce the likelihood that data on monetary positions could be used to explain differences in the sensitivity of stock returns to unexpected inflation.
4. The data on the deflators, DEF and DEFN, and on IP and M are seasonally adjusted. All of the variables are obtained from the Citibank Database.
5. To the extent that these data are revised subsequent to the initial publication, this statement is not literally true.
6. For discussion of accounting rules associated with tax deferrals see James E. Wheeler and Willard H. Galliard, An Appraisal of Interperiod Income Tax Allocation, Financial Executives Research Foundation, New York, 1974.

7. Note that the hypothesis that expected real corporate bond returns are unrelated to expected inflation is equivalent to testing $\gamma_{11} = 1.0$, and this hypothesis is rejected at the 5% significance level for the 1947-78 and 1947-63 periods.
8. Note that the monetary position variables are defined so that a nominal liability such as long-term debt has a negative sign.
9. Gonzalez-Gaviria [1975] and Freeman [1978] attempt to measure the monetary position of the firm using similar data, except that they predetermine the effect of the maturity of contracts by making a_1 a fixed proportion of a_3 (Freeman sets $a_1 = 2a_3$ and Gonzalez-Gaviria uses a couple of different weights) in order to derive a single number which measures the monetary position of the firm.
10. We use the SAS computer programs for all of the computations in this paper.
11. For example, if the covariance matrix of regression disturbances for individual firms is stationary, the covariance matrix of the 27 portfolio disturbances will vary with the changing portfolio compositions.
12. For example, firms which were not listed on the N.Y.S.E. in 1947, or not followed by COMPUSTAT in 1946, or firms which were taken over or which went bankrupt during the 1947-79 period would be excluded. Since COMPUSTAT creates tapes which cover 20 year

time intervals, there is a survival bias whereby firms which don't exist in 1965 are unlikely to have data for 1946. Similarly, firms that grew fast over the period are more likely to be included in the sample. It seems unlikely that this survival bias would affect the results of our tests.

13. Note that the phenomenon has to be stronger for firms with large amounts of debt, since a_1 is multiplied by $(LMP_{i,t-1}/S_{i,t-1})$. It is straightforward to show that the rate of return to a levered firm R_V is just the weighted average of the rates of return to the stock, R_S , and to the debt, R_D

$$R_V = \frac{S}{V} R_S + \frac{D}{V} R_D$$

where the value of the firm is $V = S + D$, which is the value of the stock plus the debt. Rearranging this equation gives

$$R_S = \frac{V}{S} R_V - \frac{D}{S} R_D ,$$

so holding R_V constant, a_1 should be 1.0, not -.17.

14. Specifically, all firms with SIC codes 4011, 4210, 4400, 4511, 4811, 4922, and 4925 were excluded from the 27 sorted portfolios and analyzed separately. The COMPUSTAT Industrial File does not contain data for electric utilities.

15. In econometric jargon, there are omitted variables which are correlated with the included variables in such a way that the regression coefficient estimators are biased toward zero.
16. Although it is unclear why firms would behave as though they were averse to inflation risk, since stockholders could presumably diversify away this risk on personal account if they wanted to do so.

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